

THE EFFECT OF BROILER CHICKEN ORIGIN ON CARCASE AND MUSCLE YIELD AND QUALITY

WPLYW POCHODZENIA KURCZĄT BROJLERÓW NA JAKOŚĆ TUSZKI I MIĘŚNI

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ABSTRACT

The aim of this study was to check the influence of broiler chicken origin on dressing percentage, meat yield and physicochemical traits of breast muscle quality. The comparative study was carried out in the period from 05.01. to 16.02.2007 on three commercial: Cobb 500 (group I), Hybro G+ (group II) and Ross 308 (group III) meat chicken hybrids.

The observed differences in the quality of carcasses and meat of the examined commercial meat hybrids were statistically significant ($p \leq 0.05$), and indicate that origin of the chickens is the main modifying factor. Meat chicken hybrids, which constitute the basis for commercial production of poultry our country, do not constitute a homogeneous material. Due to the variability over time in the offered sets of commercial meat hybrids should be monitored taking into consideration their meatness traits and basic physicochemical characteristics of meat.

Keywords: chicken, broiler, origin, carcass, meat, quality

ABSTRAKT

Celem pracy było określenie wpływu pochodzenia kurcząt brojlerów na wydajność rzeźną, dysekcyjną oraz na fizykochemiczne cechy jakości mięśni piersiowych. Badania przeprowadzono w okresie 05.01-16.02.2007 r. porównawczo dla trzech mieszańców użytkowych kur mięsnych Cobb 500 (grupa I), Hybro G+ (Grupa II) i Ross 308 (grupa III).

Stwierdzone różnice między zestawami mieszańców użytkowych kur mięsnych dla poszczególnych cech jakości tuszek i mięsa są statystycznie istotne ($p \leq 0,05$), co wskazuje, że zasadniczym czynnikiem modyfikującym jest pochodzenie kurcząt. Mieszańce kur mięsnych, stanowiące w naszym kraju bazę do pozyskiwania surowca drobiarskiego nie stanowią jednolitego materiału. Ze względu na zmienność w czasie oferowanych zestawów użytkowych mieszańców kur mięsnych, powinny być one ciągle monitorowane w zakresie cech mięsności oraz podstawowych parametrów fizykochemicznych mięsa.

Słowa kluczowe: kurczę, brojler, pochodzenie, tuszka, jakość

DETAILED ABSTRACT

Kurczęta odchowywano w jednym kurniku w boksach po 105 sztuk (średnio 14,5 szt/m²). Ogółem doświadczalna populacja liczyła 945 kurcząt (3 grupy x 3 powtórzenia x 105 sztuk). Wszystkie brojlery otrzymywały ad libitum jednakowe mieszanki paszowe typu prestarter, starter, grower i finisz. Po 42 dniowym odchowie przeprowadzono doświadczalny ubój 20 kogutków i 20 kurek z każdej. Po uboju (15 minut i 24 godziny) zmierzono stężenie jonów wodorowych (pH₁₅ i pH₂₄), temperaturę oraz przeprowadzono uproszczoną dysekcję (Ziołocki i Doruchowski 1989). Pobrano mięśnie od 16 tuszek z każdej grupy doświadczalnej kurcząt brojlerów danej płci do badań wodochłonności oraz podstawowego składu chemicznego. Mięśnie przeznaczone do tych oznaczeń były pozbawione skóry z tłuszczem podskórnym.

Istotne różnice stwierdzono dla masy ciała ptaków uwzględniając ich płć. Kogutki były istotnie cięższe o 192 do 296g. Kurczęta grupy III, zarówno kogutki, jak i kurki charakteryzowały się istotnie najniższą wydajnością rzeźną – poniżej 71%. Doświadczalne populacje kurcząt brojlerów cechowały się wyższą o 2,96 do 3,64% zawartością mięśni piersiowych w stosunku do mięśni nóg. W tuszkach grupy III kurcząt wykazano duży udział tłuszczu sadelkowego (1,72%). Była to różnica statystycznie istotna wobec pozostałych grup doświadczalnych.

Korzystniejszymi parametrami fizycznymi charakteryzowały się mięśnie piersiowe kurcząt grupy II i III. Stężenie jonów wodorowych mierzone bezpośrednio po uboju (pH₁₅) w mięśniu piersiowym kurcząt grupy I było najwyższe i wynosiło 6,26, a po 24 godzinach obniżyło się o 0,25 jednostek.

Mięśnie piersiowe grupy III kurcząt, charakteryzowały się niską zawartością tłuszczu (2,07%) i wody (69,70%), a wysoką zawartością białka ogólnego (24,02%).

Stwierdzona wysoka zawartość mięśni ogółem, wynosząca około 45% tuszki patroszonej, potwierdza, że współczesne mieszańce użytkowe kur mięsnych są bardzo dobrym surowcem drobiarskim. Szczególnie, że w tej ilości najcenniejszy surowiec - mięśnie piersiowe stanowiły ponad 24%. Moran 1997 badając cztery komercyjne zestawy kurcząt brojlerów, wykazał także istotne różnice (1,50%) w zawartości mięśni piersiowych w tuszce w zależności od pochodzenia.

Stosunkowo wysokie i zróżnicowane wartości odczynu pH₁₅ mięśni piersiowych odzwierciedlają różną szybkość glikolizy poubojowej oraz potwierdzają wyniki prezentowane przez Richardson'a 2004.

Wykazano, że spośród ocenianych populacji mieszańców

użytkowych kur mięsnych, grupa III różni się istotnie ($p \leq 0,05$) w zakresie wielu badanych cech jakości tuszek i mięsa. Także Szałkowska i Meller 1997 oraz Smolińska 1998 wykazali różnice w składzie chemicznym mięśni piersiowych i udowych kurcząt różnych zestawów mieszańców kur.

Stwierdzone w badaniach własnych różnice między zestawami mieszańców użytkowych kur mięsnych dla poszczególnych cech jakości tuszek i mięsa są statystycznie istotne ($p \leq 0,05$), co wskazuje, że zasadniczym czynnikiem modyfikującym jest pochodzenie kurcząt. Mieszańce kur mięsnych, stanowiące w naszym kraju bazę do pozyskiwania surowca drobiarskiego nie stanowią jednolitego materiału.

INTRODUCTION

In the nineties of the previous century the research in poultry genetics carried out in breeding companies concentrated on developing new commercial hybrids of meat chicken having the desired performance traits, e.g. particularly large weight of the breast muscles used in further processed meat products. For example, the white feathered chicken: Hybro N, Indian River, Avian 34, Hybro G and Cobb 500 are typical broilers, while the first three have been mainly used in the production of whole carcasses and the other two have a multi-purpose character and the autosexing trait, and their commercial utilisation of carcasses is dependent on the final body weight and on rearing management system. On the other hand, Hubbard Hi-Y, Ross 308 and 508 or Avian 24K broilers are especially used by the further processing plants. The red-feathered Redbro broilers have slower growth rate, darker meat colour and are preferred by gourmards of high sensory requirements [2]. It can be assumed that every two to three years the majority of breeding companies offer on the market new commercial hybrids of broiler chicken, which replace the former ones sold so far. For example, Ross broilers initially known as Ross 200, have afterwards been marketed as 308, 508 whereas Ross 708 is often sold nowadays [5, 6].

In the time of greatly developed further processing of poultry meat and high consumer requirements it seems to be inevitable to undertake studies on the topic to which extent the diversified bird origin can affect quality traits of broiler chicken meat [9, 15, 1, 7, 20]. It particularly pertains to new bird strains which are used in the production of commercial meat chicken hybrids dominating on the Polish poultry market, namely Cobb 500, Hybro G+, Ross 308 [4, 17].

The purpose of this study was the determination of the effect of broiler chicken origin on slaughter and meat

yield and the physicochemical quality traits of breast muscles. In the experiment commercial broiler chickens Cobb 500 (group I), Hybro G+ (group II) and Ross 308 (group III) were reared and compared in the period from 05.01. to 16.02.2007.

MATERIAL AND METHODS

Birds were reared in one poultry house in pens of 105 birds each (14.5 bird/m² on average). The pens were regularly distributed in the poultry house and birds in each pen were meant as one replication of the given experimental group. The environmental and management condition during the rearing period were comparable with the commercial ones being found in the instructions and were a compromise among slightly different requirements established by various broiler chicken producers. The total of the experimental population comprised 945 broilers (3 groups × 3 replication × 105 birds). All broilers were fed ad libitum on compound feed of prestarter, starter, grower and finisher type. After 42 days of growing period, 20 males and 20 females were taken from each group (3 groups × 20 males × 20 females = 120 birds) and

slaughtered in a commercial slaughter plant located 32 km from the farm and subjected to standardized processing conditions of broilers. Concentration of hydrogen ions (pH₁₅) and body temperature were measured 15 minutes after slaughter. Carcasses were left in the cold (4°C). On the next day 24 h postmortem, the eviscerated carcasses were individually weighed, the pH₂₄ and temperature₂₄ determined and a simplified dissection carried out [21] in the laboratory of the experimental station Zakrzewo of the PIB Institute of Animal Husbandry. All measurements of pH and temperature were carried out in the left pectoralis profundus muscle. The concentration of the hydrogen ions was measured with the use of mobile Metter-Toledo pehameter (Switzerland) type MP125DE with Inlab 427 calomel electrode.

From 16 carcasses of each group of the given sex, pectoralis superficialis and profundus muscles were taken for the determination of water holding capacity acc. to modified method of Grau and Hamm [3] and determination of the basic chemical composition of muscles [10, 11, 12, 13]. The muscles used in the analyses were without skin with the subcutaneous fat tissue.

The results of laboratory measurements in groups of birds

Table 1. Dressing percentage broiler chicken
Tabela 1. Wydajność rzeźna kurcząt brojlerów

Group Grupa	I			II			III		
Traits Cecha	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀
Body weight before the slaughter, g									
Masa ciała przed ubojem, g									
\bar{x}	2421 ^a	2178 ^{cd}	2300 ^b	2343 ^b	2151 ^{cd}	2247 ^{bc}	2422 ^a	2126 ^d	2274 ^b
s	130	138	134	140	90	118	81	110	96
V	5.4	6.3	5.8	6.0	4.2	5.2	3.3	5.2	4.2
SEM	37.01	37.01	26.17	37.01	37.01	26.17	37.01	37.01	26.17
Carcase weight with the neck (without giblets), g									
Masa tuszki z szyją (bez podrobów), g									
\bar{x}	1726 ^a	1555 ^d	1641 ^{bc}	1687 ^{ab}	1538 ^d	1612 ^c	1718 ^a	1499 ^d	1609 ^c
s	131	138	134.27	109	74	93.48	73	81	76.95
V	7.6	8.9	8.2	6.5	4.8	5.8	4.2	5.4	4.8
SEM	33.01	33.01	23.34	33.01	33.01	23.34	33.01	33.01	23.34
Dressing percentage, %									
Wydajność rzeźna, %									
\bar{x}	71.24 ^{bc}	71.34 ^b	71.29 ^b	71.97 ^a	71.51 ^a	71.66 ^a	70.95 ^c	70.50 ^d	70.72 ^d
s	2.28	2.72	2.51	0.84	2.72	2.01	1.58	1.52	1.55
V	3.2	3.8	3.5	1.2	3.8	2.8	2.2	2.2	2.2
SEM	0.65	0.65	0.46	0.65	0.65	0.46	0.65	0.65	0.46

Explanation/ Objasnienie:

\bar{X} - average value, s-standard variation, v -- variation coefficient

\bar{X} - wartość średnia, s- odchylenie standardowe, v - współczynnik zmienności

^{ab} - various letters in rows denote statistically significant difference at $p \leq 0.05$

^{ab} - various letters in the lines mark the statistically relevancy of the differences $p \leq 0,05$

were subjected to analysis of variance and the means, standard deviation, variance coefficient and standard error were calculated.

RESULTS

Mean body weight of broilers prior to slaughter amounted from 2247 (group II) to 2300 g (group I) as presented in Table 1. Significant weight differences were found as to be affected by sex of birds. Males were significantly heavier from 192 to 296 grams. Birds in group III, of both sexes, demonstrated the lowest preslaughter weight, below 71%, but on the other hand, the highest one (71.66%) was found in group II. Attention has to be drawn to considerable equalisation of the trait in question in the several experimental population since the variation coefficient did not exceed 3.8%.

The results of carcass dissection (Figures 1 and 2) revealed in the examined broiler populations higher by 2.96 to 3.64% breast muscle yield in comparison with that in the legs. Particular attention is drawn to the group III of birds in which the carcasses of males and females were found to have similar breast muscle yield, i.e. 24.51 and 24.30%, respectively. The breast muscle yield in the two other groups was statistically different as dependent on sex.

In the carcasses of group III a large content of

peritoneal depot fat (1.72%) was noted, which was statistically different in comparison with the other groups of broilers. Moreover, the carcasses of group III demonstrated significantly lower yield of skeleton with the adjacent back musculature (28.39%).

Among the other carcass elements separated during dissection, attention is drawn to the similar yield of wings and neck in all groups of birds.

The analysis of the physical traits of breast muscles (Table 2) revealed more beneficial ones in the muscles of carcasses in groups II and III. Taking bird sex into consideration, such results were found in the females. Concentration of hydrogen ions determined in the breast muscles immediately after bird slaughter (pH_{15}) was highest in group I and amounted to 6.26, and then dropped by 0.25 units 24 h after slaughter. The examined physical traits of the breast muscles were on similar level in the studied broiler populations, particularly in the case of pH values in which the variation coefficients were below 3.0%. On the other hand, the muscle temperature 24h postmortem was very diversified in groups II and III and the noted variation coefficients ranged from 6.9 to 29.8%.

As far as the basic chemical composition of breast muscles is concerned (Table 3), attention has to be drawn to the muscles in group II where low fat (2.07%)

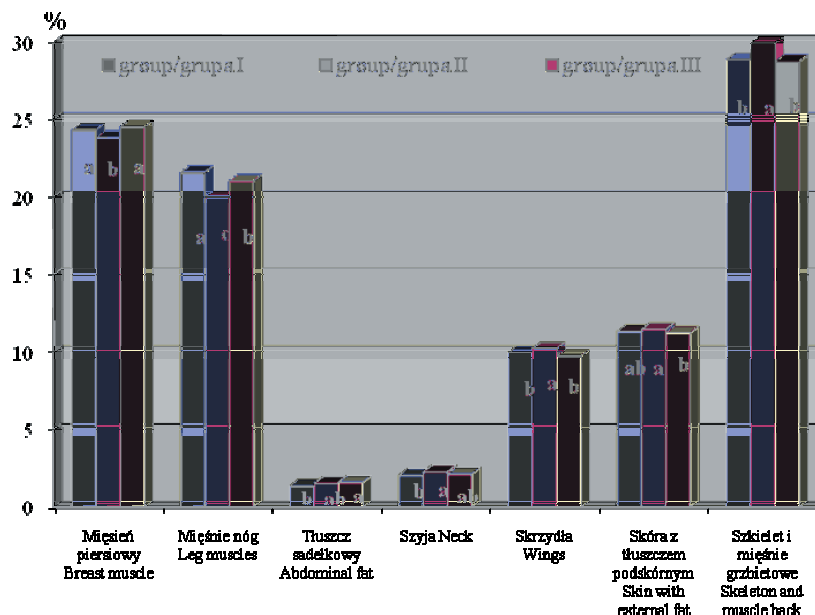


Fig. 1. Percentage yield of given elements in comparison with the weight of carcass with the neck but without giblets – males

Rys. 1. Wydajność dysekcyjna - procentowy udział poszczególnych elementów w stosunku do masy tuszki patroszonej z szyją bez podrobów – kogutki

and water (69.70%), but high crude protein content were noted. However, taking bird sex into consideration the breast muscles in females contained slightly more crude protein and less fat. The observed differences were statistically non significant among all evaluated bird populations. Moreover, the variation coefficient in the case of fat content in the breast muscles was found to be above 10%.

DISCUSSION

Broiler body weight prior to slaughter was on similar level among groups and no statistically significant differences were noted as it has been planned in the programme of study. The three examined groups of commercial broilers demonstrated high slaughter yield, above 70.50%, which was not dependent on bird sex and similar in all populations thus indicating that trait is on stable level in breeding meat type chicken.

The observed high total yield of muscles that attained circa 45% of the eviscerated carcass weight confirms that the present commercial hybrids of the meat type chicken are a very good material for poultry meat production. In that meat quantity, the breast muscles which are meat of the highest quality represented more than 24%. The differences in that trait observed in groups I and II of broilers due to bird sex can indicate that rearing males and

females separately is justified to obtain more equalised body weight prior to bird slaughter. In 1997 Moran [8] examined four commercial hybrids of broiler chicken and demonstrated significant differences (1.50%) in the breast muscle yield in the carcass as dependent on bird origin. Such differences were not observed in the case of bird sex.

The relatively high and diversified values of pH₁₅ in the breast muscles illustrate different glycolysis rate postmortem and confirm the results of study by Richardson [14]. That author demonstrated the metabolism of present day broiler chicken muscles is very fast and comparable with that observed in red meat animals.

Among the evaluated populations of meat type chicken hybrids, the group III differed significantly at p ≤ 0.05 in the case of many examined quality traits of carcass and meat. The breast muscle yield in that broiler group was on similar level both in male and female birds. Moreover they demonstrated high content of peritoneal depot fat. On the other hand, the breast muscles were found to have low intramuscular fat content (difference from 0.22 to 0.29%) and water content (difference from 0.81 to 0.83%) but higher crude protein content (difference from 0.95 to 1.46%). Smolińska [16] also observed differences in the chemical composition of breast and leg muscles of Starbro and Vedette broiler chickens. Those

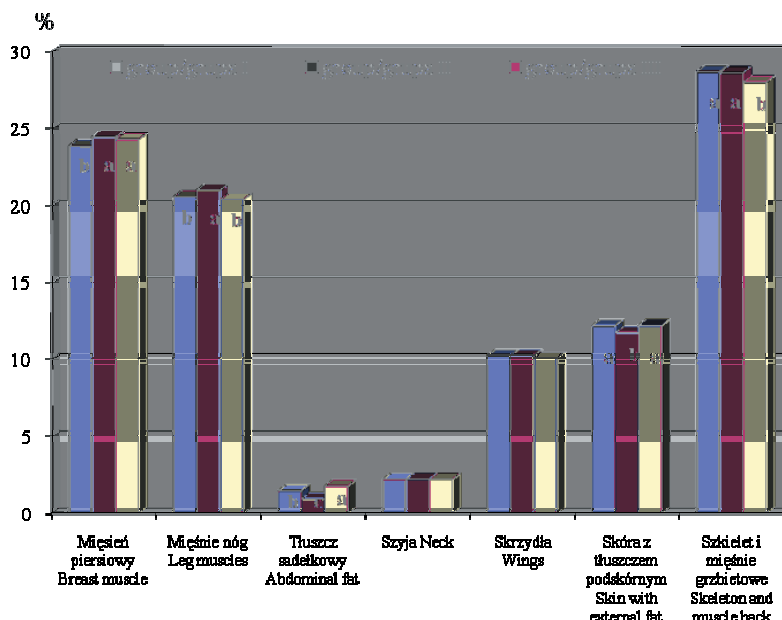


Fig. 2. Percentage yield of given elements in comparison with the weight of carcass with the neck but without giblets – females

Rys. 2. Wydajność dysekcyjna - procentowy udział poszczególnych elementów w stosunku do masy tuszki patroszonej z szyją bez podrobów – kurki

Table 2. Results of meat quality traits of breast muscles of broiler chicken
Tabela 2. Wyniki badań cech fizycznych mięśni piersiowych kurcząt brojlerów

Group Grupa	I			II			III		
Traits Cecha	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀
pH₁₅									
\bar{x}	6.30 ^a	6.22 ^{ab}	6.26 ^a	6.17 ^b	6.17 ^b	6.17 ^{ab}	6.18 ^b	6.13 ^b	6.15 ^b
s	0.16	0.18	0.17	0.19	0.13	0.16	0.13	0.12	0.12
V	2.5	2.8	2.7	3.0	2.2	2.6	2.0	1.9	2.0
SEM	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.03
pH₂₄									
\bar{x}	6.01 ^{ab}	6.01 ^{ab}	6.01	5.97 ^{ab}	5.94 ^b	5.96	5.95 ^b	5.95 ^b	5.95
s	0.10	0.07	0.08	0.08	0.07	0.08	0.11	0.11	0.11
V	1.6	1.2	1.4	1.4	1.2	1.3	1.8	1.9	1.8
SEM	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
temp₁₅, °C									
\bar{x}	29.07 ^a	28.00 ^b	28.53 ^a	29.27 ^a	26.40 ^c	27.83 ^b	25.53 ^d	25.13 ^d	25.33 ^d
s	1.1	0.76	0.94	2.63	1.55	2.16	1.00	1.92	1.53
V	3.8	2.7	3.3	9.0	5.9	7.8	3.9	7.6	6.0
SEM	0.42	0.42	0.30	0.42	0.42	0.30	0.42	0.42	0.30
temp₂₄, °C									
\bar{x}	7.00 ^c	6.67 ^c	6.83 ^b	8.13 ^b	9.07 ^a	8.60 ^a	5.13 ^d	6.27 ^c	5.70 ^c
s	0.00	0.49	0.35	1.36	1.71	1.54	0.35	1.87	1.35
V	0.0	7.3	5.0	16.7	18.9	17.9	6.9	29.8	23.6
SEM	0.31	0.31	0.22	0.31	0.31	0.22	0.31	0.31	0.22
Water-holding-capacity, mg%									
Wodochłonność, mg%									
\bar{x}	30.74 ^{bc}	31.02 ^c	30.88 ^c	31.51 ^d	29.65 ^a	30.58 ^{bc}	29.61 ^a	30.59 ^b	30.10 ^a
s	3.97	3.54	3.76	2.45	2.54	2.50	3.34	3.98	3.67
V	5.7	5.1	5.4	3.6	3.6	3.6	4.7	5.7	5.3
SEM	1.06	1.06	0.75	1.06	1.06	0.75	1.06	1.06	0.75

Explanation/ Objasnienie:

\bar{x} - average value, s-standard variation, v – variation coefficient

\bar{x} - wartość średnia, s- odchylenie standardowe, v – współczynnik zmienności

^{ab} - various letters in rows denote statistically significant difference at $p \leq 0.05$

^{ab} - różne litery w wierszach oznaczają statystyczną istotność różnic $p \leq 0,05$

differences in the protein content amounted to 0.62% in the breast muscle and to 0.49% in the thigh muscle and the differences in fat content amounted to 1.05% and 1.06%, respectively.

In 1997 Szalkowska i Meller [18] compared two genetic lines Hybryd A and Hybryd B, taking into account the effect of bird age and genotype on the quality and technological usefulness of broiler chicken meat. The results of analyses differed significantly at $p \leq 0.01$ in the content of protein and dry matter but no statistically significant differences were observed in the fat content. The differences in the basic chemical composition of chicken broiler muscles found in this study and also reported by other authors were dependent on bird origin, however, their quantities appeared different in the examined populations.

In the present time diminishing amounts of broiler meat as whole carcasses are offered on the market and consumed. Therefore the significant differences among populations in the breast meat yield and in chemical composition observed in this study can be used as guidelines in the further processing technology of broiler meat.

CONCLUSIONS

The differences among hybrids of meat type chicken noted in several quality traits of carcass and found statistically significant at $p \leq 0.05$ have demonstrated that bird origin is the principal modifying factor in that field.

Broilers chicken hybrids in Poland being used in the commercial production of poultry meat are not a uniform material.

Table 3. Results of the examination of basic chemical components of breast muscles of chicken broiler

Tabela 3. Wyniki badań podstawowego składu chemicznego mięśni piersiowych kurcząt brojlerów

Group Grupa	I			II			III		
Traits Cecha	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀
Total protein, % Białko ogólne, %									
\bar{x}	22.56 ^b	22.56 ^b	22.56 ^b	22.50 ^b	23.63 ^a	23.07 ^b	23.97 ^a	24.06 ^a	24.02 ^a
s	0.90	0.78	0.84	0.94	0.72	0.84	0.86	0.77	0.82
V	4.0	3.5	3.7	4.2	3.0	3.6	3.6	3.2	3.4
SEM	0.26	0.26	0.19	0.26	0.26	0.19	0.26	0.26	0.19
Fat, % Tłuszcz, %									
\bar{x}	2.49 ^a	2.23 ^{ab}	2.36 ^a	2.39 ^a	2.18 ^b	2.29 ^{ab}	2.09 ^b	2.05 ^b	2.07 ^b
s	0.40	0.28	0.35	0.37	0.32	0.35	0.73	0.43	0.60
V	16.2	12.7	14.8	15.6	14.8	15.2	34.8	21.0	28.9
SEM	0.14	0.14	0.10	0.14	0.14	0.10	0.14	0.14	0.10
Ash, % Popiół, %									
\bar{x}	3.57 ^a	3.61 ^a	3.59 ^a	3.44 ^{ab}	3.36 ^b	3.40 ^b	3.56 ^a	3.48 ^{ab}	3.52 ^{ab}
s	0.20	0.25	0.23	0.25	0.35	0.30	0.27	0.25	0.26
V	5.6	7.1	6.4	7.4	10.3	9.0	7.6	7.1	7.4
SEM	0.08	0.08	0.06	0.08	0.08	0.06	0.08	0.08	0.06
Water, % Woda, %									
\bar{x}	70.35 ^{ab}	70.71 ^{ab}	70.53 ^a	70.87 ^a	70.15 ^{ab}	70.51 ^a	69.60 ^b	69.80 ^b	69.70 ^b
s	0.93	0.74	0.84	1.13	0.77	0.97	1.39	1.35	1.37
V	1.3	1.1	1.2	1.6	1.1	1.4	2.0	1.9	2.0
SEM	0.34	0.34	0.24	0.34	0.34	0.24	0.34	0.34	0.24

Explanation/Objaśnienie:

 \bar{x} - average value, s-standard variation, v - factor of variability \bar{x} - wartość średnia, s- odchylenie standardowe, v - współczynnik zmienności^{ab} - various letters in the lines mark the statistically relevancy of the differences $p \leq 0,05$ ^{ab} - różne litery w wierszach oznaczają statystyczną istotność różnic $p \leq 0,05$

Due to observed differentiation over time in the main quality traits of the commercial hybrids of broiler chicken it is required to continuously monitor their meat performance traits and basic chemical composition of meat.

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